

Powering a Sustainable Future

Idaho National Laboratory provides technical direction for the Generation IV International Forum and engages in supporting research.

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07-GA50728-01b

The Generation IV International Forum A Partnership for Sustainable Nuclear Energy Systems

The first meeting of countries that led to the formation of the Generation IV International Forum (GIF) was held in January 2000 in Washington, D.C. It was attended by representatives of nine countries, and began with a general discussion of their common interest in new nuclear energy systems. The meeting resulted in a joint statement on the need for a next generation, known as Generation IV, and the desire to cooperate in research and development.

The figure on page 2 gives an overview of the generations of

nuclear energy systems. The first generation was advanced in the 1950s and 1960s with early prototype reactors. The second generation began in the 1970s in the large commercial power plants that are still operating today. Generation III was developed more recently in the 1990s with a number of evolutionary designs that offer significant advances in safety and economics, and a number have been built – primarily in East Asia. Advances to Generation III are under way, resulting in several Generation III+ near-term deployable plants that are

actively under development and are being considered for deployment in several countries. New plants built in the nearer term will likely be chosen from these designs. In the longer term, the prospect for innovative advances through renewed R&D has stimulated interest worldwide in a fourth generation of nuclear energy systems.

Today, the GIF has ten active members joined together to develop future-generation nuclear energy systems that can be licensed, constructed and

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Nuclear Programs





Today the GIF has ten active members: Canada, China, Euratom, France, Japan, Russia, South Korea, South Africa, Switzerland and the United States.

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operated in a manner that will provide competitively priced, reliable energy products while satisfactorily addressing nuclear safety, waste, proliferation and public perception concerns. The objective for Generation IV nuclear energy systems is to have them available for international deployment by 2030 or sooner.

From the beginning, the desire of the member countries was to have a flexible arrangement for working together to define Generation IV systems and their required R&D. The GIF Charter was developed in July 2001. The GIF operates with a Policy Group that acts as a decision-making body for high-level initiatives and issues, and an Experts Group that acts as oversight

to R&D collaborations. Both groups operate with representatives from each member nation. The Charter has provisions for a modest Secretariat initially hosted by the United States, and now by France. There are no permanent facilities or staff, and the member countries contribute part-time staff to attend meetings and develop needed documents. The Nuclear Energy Agency provides a technical secretariat for the various groups within the GIF.

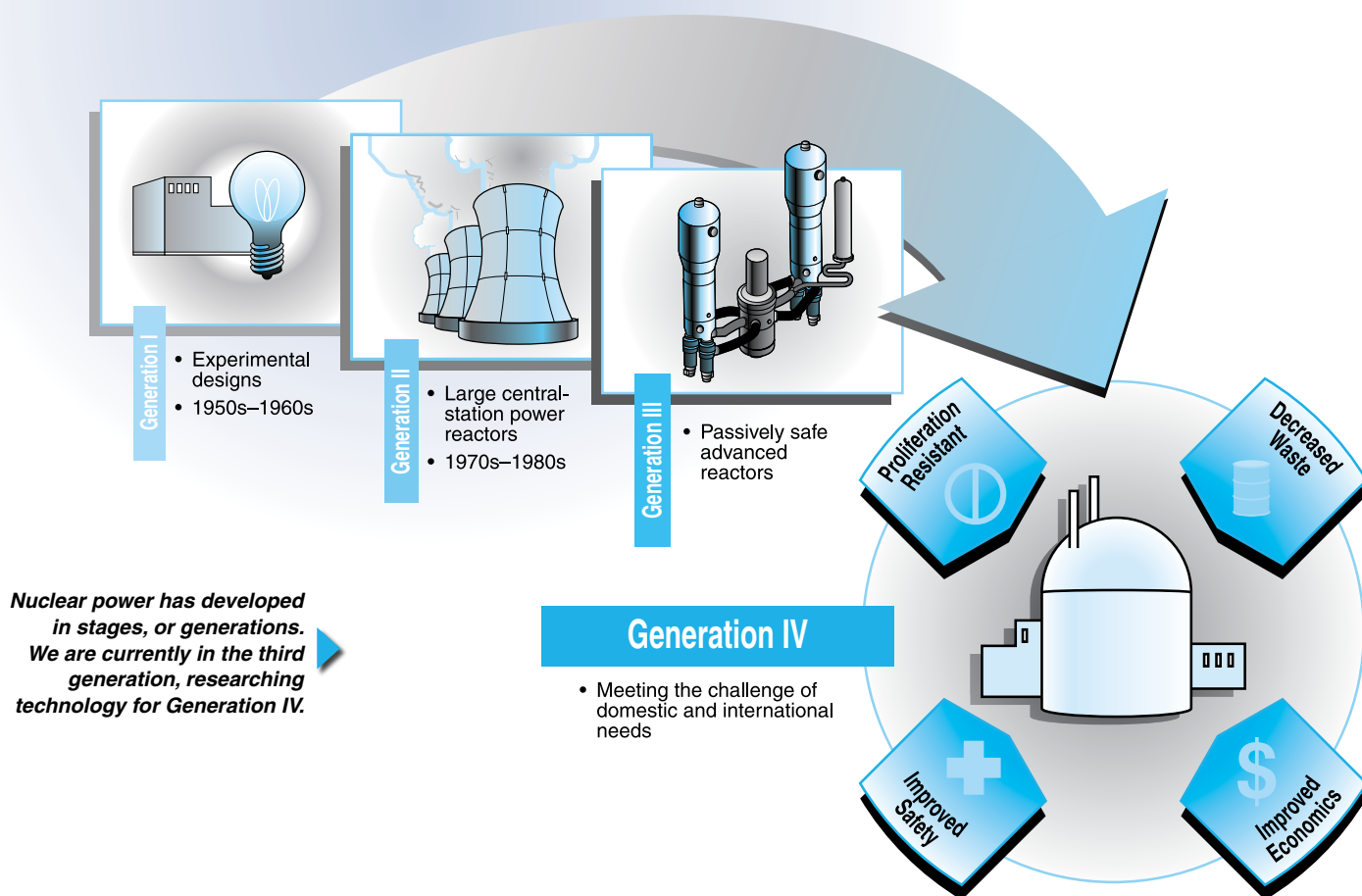
The primary activities of the GIF are to:

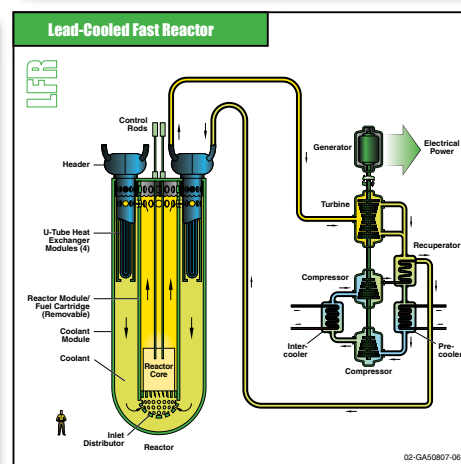
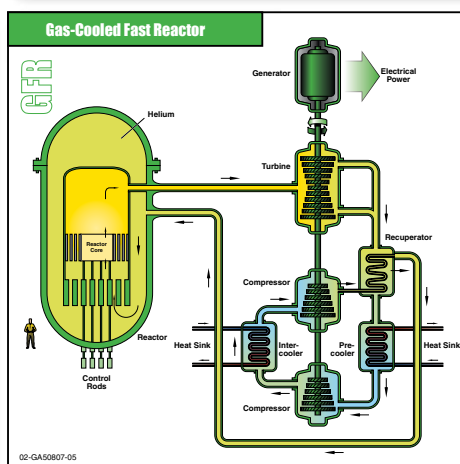
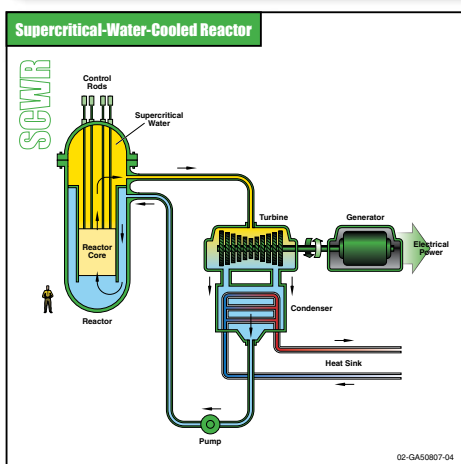
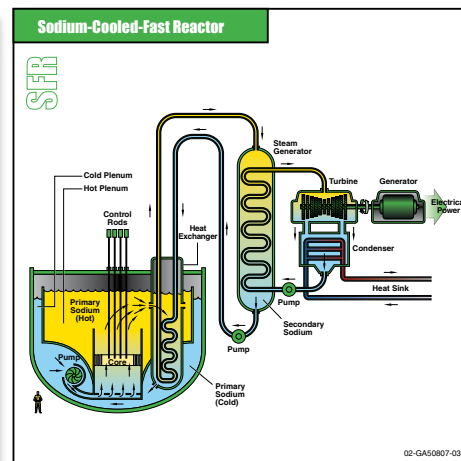
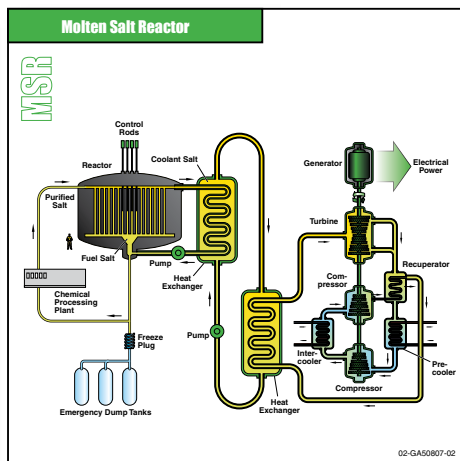
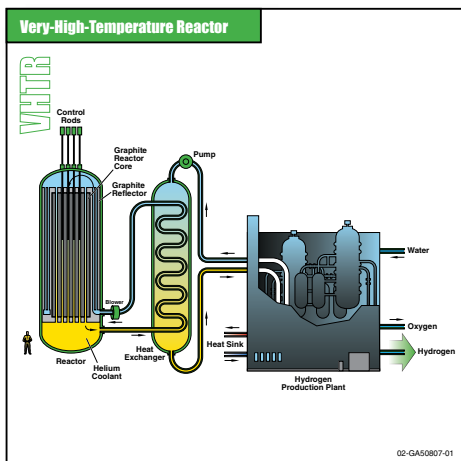
- Identify potential areas of multilateral collaboration on Generation IV nuclear energy systems,
- Foster collaborative R&D projects,

- Establish guidelines for the collaborations and reporting of their results,
- Regularly review progress and make recommendations on the direction of collaborative R&D projects,
- Establish and regularly review an inventory of the potential areas of needed research, and
- Conduct such other activities to advance achievement of GIF's objectives as the members may jointly determine.

From the early interactions of the members, it was apparent that the objectives of the R&D deserved further development. Two activities were spawned: the Policy and Experts Groups began working on a set of goals for Generation IV systems, and

The GIF Charter can be viewed at <http://www.gen-4.org/PDFs/GIFcharter.pdf>





a major activity was started to produce a technology roadmap. Roadmapping is a methodology used to define and manage the planning and execution of large-scale R&D efforts.

The Generation IV Roadmap

The GIF agreed to support the preparation of a roadmap, and the roadmap became the focal point of their efforts. More than one hundred technical experts from ten countries contributed to its preparation. The scope of the R&D described in this roadmap covers all of the Generation IV systems. However, each GIF member will focus on those systems and the subset of R&D activities that are of greatest interest to them. Thus,

the roadmap provides a foundation for formulating national and international program plans on which the GIF countries will collaborate to advance Generation IV systems.

Eight goals for Generation IV were defined in the four broad areas of sustainability, economics, safety and reliability, and proliferation resistance and physical protection. Sustainability goals focus on fuel utilization and waste management. Economics goals focus on competitive life cycle and energy production costs and financial risk. Safety and reliability goals focus on safe and reliable operation, improved accident management and minimization of consequences, investment protection, and

essentially eliminating the technical need for off-site emergency response. The proliferation resistance and physical protection goal focuses on controlling and securing nuclear material and nuclear facilities.

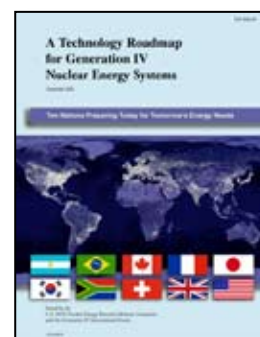
The eight technology goals for Generation IV nuclear energy systems are:

- Sustainability–1. Generation IV nuclear energy systems including fuel cycles will provide sustainable energy generation that meets clean air objectives and promotes long-term availability of systems and effective fuel utilization for worldwide energy production.

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Six technologies were selected for further Generation IV nuclear power systems research.

More than one hundred technical experts from ten countries contributed to the preparation of the Generation IV Roadmap.



For more information

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GIF Website
www.gen-4.org

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- Sustainability–2. Generation IV nuclear energy systems will minimize and manage their nuclear waste and notably reduce the long-term stewardship burden in the future, thereby improving protection for the public health and the environment.
- Safety and Reliability–1. Generation IV nuclear energy systems operations will excel in safety and reliability.
- Safety and Reliability–2. Generation IV nuclear energy systems will have a very low likelihood and degree of reactor core damage.
- Safety and Reliability–3. Generation IV nuclear energy systems will eliminate the need for offsite emergency response.
- Economics–1. Generation IV nuclear energy systems will have a clear life-cycle cost advantage over other energy sources.
- Economics–2. Generation IV nuclear energy systems will have a level of financial risk comparable to other energy projects.
- Proliferation Resistance and Physical Protection–1. Generation IV nuclear energy systems, including fuel cycles, will increase the assurance that they are a very unattractive and least desirable route for diversion or theft of weapons-usable materials and provide increased physical protection against acts of terrorism.

The Generation IV roadmap process culminated in the selection of six Generation IV systems, shown in the figures on page 3. The motivation for the

selection of six systems is to:

- Identify systems that make significant advances toward the technology goals
- Ensure that the important missions of electricity generation, hydrogen and process heat production, and actinide management may be adequately addressed by Generation IV systems
- Provide some overlapping coverage of capabilities, because not all of the systems may ultimately be viable or attain their performance objectives and attract commercial deployment
- Accommodate the range of national priorities and interests of the GIF countries.

The GIF Framework Agreement, Systems and Projects

As the Generation IV Technology Roadmap was completed, planning started for collaborative R&D. Provisional steering committees were formed for the systems that guide the R&D and oversee collaborative efforts. In order to establish multilateral collaboration on nuclear energy, however, an agreement among the governments was needed. Created in February 2005, the GIF Framework Agreement is considered a treaty-level document by the nations that accede to it. As of today, seven of the nine active members have acceded, and the remainder are making preparations.

The Framework Agreement establishes two organizational levels: System and Project. At the system level, each of the six Generation IV systems has a System Steering Committee to oversee the objectives and research activi-

ties. The representatives on the committees are typically energy ministry or department officials, or research directors from research agencies or commissions within the member country. The SFR Steering Committee was formally created in January 2006, and has representatives from the EU, France, Japan, South Korea and the U.S. The GFR, SCWR and VHTR committees were created in November 2006. Each committee establishes a System Research Plan to establish the overall research objectives and timelines.

Within each system, several Project Management boards are established to define and execute the R&D. Each board concentrates on a broad area of the technology, such as fuels and materials, energy conversion, balance of plant, etc. The representatives in the projects can involve universities, industries, laboratories and others willing to commit their resources or unique facilities to the collaboration. The first board was created in March 2007 for Advanced Fuels development within the SFR. Many others are being formed now.

Summary

The GIF endeavors to provide nuclear energy systems for a sustainable nuclear energy future. It has developed from an initial discussion among countries with a common interest in new nuclear energy systems, into a developing framework for collaborations on the R&D needed to advance toward Generation IV systems. The framework now includes formal agreements for creating multilateral nuclear energy R&D projects.